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/Douglas Godbold/

S/N 10/671,324 **PATENT**

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	Vinod Prakash et al.	Examiner: Douglas C. Godbold
Serial No.:	10/671,324	Group Art Unit: 2626
Filed:	September 25, 2003	Docket No.: 1864.001US1
Title:	SYSTEM, METHOD, AND APPARATUS FOR FAST QUANTIZATION IN PERCEPTUAL AUDIO CODERS	

AMENDMENT & RESPONSE UNDER 37 C.F.R. 1.116

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In response to the Final Office Action mailed September 10, 2008, please amend the application as follows:

IN THE CLAIMS

Please amend the claims as follows:

1. (Currently Amended) A method for real-time encoding of an audio signal comprising:

grouping spectral lines to form scale band factors by determining masking thresholds based on human perception system;

shaping quantization noise in spectral lines in each scale band factor using local gain, wherein the local gain of the scale band factor are estimated as a function of ~~by assigning quantization precision based on~~ band energy ratios and SMRs, wherein the shaping the quantization noise in each scale band factor such that a difference between SMR and SNR in each scale band factor is substantially constant; and

running a loop for each scale band factor to satisfy a predetermined bit allocation rate based on a bit allocation scheme.

2. (Canceled)

3. (Canceled)

4. (Previously Presented) The method of claim1, wherein shaping the quantization noise in each scale band factor such that the difference between SMR and SNR is substantially constant comprises:

assigning a higher quantization precision to scale band factors having a high SMR; and

assigning quantization precision to each scale band factor that is inversely in proportion to their energy content with respect to frame energy to desensitize the scale factor bands.

5. (Currently Amended) A single-loop quantization method for band-by-band coding of an audio signal comprising:

calculating local gain for each band; and

shaping quantization noise in each band using local gain, wherein the local gain of the band are estimated as a function of ~~by assigning quantization precision based on by~~ band energy ratios and SMRs, wherein the shaping the quantization noise in spectral lines in each band such that a difference between Signal-to-Mask Ratio (SMR) and Signal-to-Noise Ratio (SNR) in each band is substantially constant.

6. (Original) The method of claim 5, wherein shaping the quantization noise in each band using its local gain comprises:

shaping the quantization noise in each band by setting a scale factor in each band based on its psychoacoustic parameters and energy ratio.

7. (Canceled)

8. (Previously Presented) The method of claim 5, wherein the spectral lines are derived by performing a time to frequency transformation of the audio signal.

9. (Previously Presented) The method of claim 5, further comprising:

partitioning the audio signal into a sequence of successive frames;

forming bands including groups of neighboring spectral lines for each frame based on critical bands of hearing; and

computing local gain for each band.

10. (Previously Presented) The method of claim 5, wherein shaping the quantization noise in each band such that the difference between SMR and SNR is substantially constant comprises:

assigning a higher quantization precision to bands having a higher SMR; and

further assigning quantization precision to each band such that the assigned quantization precision is inversely in proportion to their energy content with respect to band energy to desensitize the bands.

11. (Previously Presented) A single-loop quantization method for band-by-band coding of

an audio signal comprising:

calculating local gain for each band; and

shaping quantization noise in each band using its local gain, wherein the local gain in each band is derived using the equation:

K_b=-(int)(a * log2(en(b)/sum_en) + β* log2 (SMR(b)))

wherein K_b is the local gain for each band, *log2* is logarithm to *base* 2, *en(b)* is the band energy in band *b, sum_en* is total energy in a frame, *SMR(b)* is the psychoacoustic threshold for band b, wherein *a* measures weightage due to energy ratio, and β is a weightage due to SMRs.

12. (Currently Amended) A method for encoding an audio signal, based on a perceptual model, comprising quantization noise shaping of spectral lines on a band-by-band basis <u>using local gain, wherein the local gain of the band are estimated as a function of</u> ~~by assigning quantization precision based on~~ band energy ratios and SMRs such that a difference between SMR and SNR is held substantially constant for each band, wherein the energy ratios are computed by dividing energy in each band over sum of energies in all bands.

13. (Canceled)

14. (Canceled)

15. (Original) The method of claim 12, wherein the quantization noise shaping of each scale band factor such that the difference between SMR and SNR is substantially constant comprises:

assigning a higher quantization precision to bands having a high SMR; and

assigning a quantization precision to each band that is inversely in proportion to their energy content with respect to band energy to desensitizing the bands.

16. (Original) The method of claim 15, wherein fitting the noise shaped spectral lines comprises:

estimating a bit demand for each band: and

allocating the estimated bit demand based on a predetermined bit rate.

17. (Currently Amended) An apparatus comprising an encoder to quantize an audio signal based on a perceptual model comprising quantization noise shaping of spectral lines on a band by-band basis using local gain, wherein the local gain of the band are estimated as a function of ~~by assigning quantization precision based on by~~ band energy and SMRs and fitting spectral lines within each band based on a given bit rate, wherein the quantization noise shaping the spectral lines on the band-by-band basis such that the difference between SMR and SNR is substantially constant in each band.

18. (Canceled)

19. (Previously Presented) The apparatus of claim17, wherein the local gains are derived from energy ratios and SMRs in each band.

20. (Previously Presented) A single-loop quantization method for band-by-band coding of an audio signal comprising:

calculating local gain for each band; and

shaping quantization noise in each band using its local gain, wherein the local gains are derived using the equation:

K_b=-(int)(a * log2(en(b)/sum_en) + β * log2 (SMR(b)))

wherein K_b is the local gain for each scale band factor, *log2* is logarithm to *base* 2, *en(b)* is the band energy in scale band factor *b, sum_en* is the total energy in a frame, *SMR(b)* is the psychoacoustic threshold for scale band factor *b,* wherein *a* measure weightage due to energy ratio, and β is the weightage due to SMRs.

21. (Currently Amended) An apparatus for coding a signal based on a perceptual model, comprising:

means for shaping quantization noise in spectral lines on a band-by-band basis using local gain, wherein the local gain of the band are estimated as a function of ~~by assigning quantization precision based on by~~ band energy ratios and SMRs, wherein the means for shaping

quantization noise in the spectral lines such that the difference between SMR and SNR is substantially constant for each band; and

means for quantizing the shaped spectral lines in each band based on a predetermined bit rate.

22. (Original) The apparatus of claim 21, further comprising:

means for partitioning the signal into a sequence of successive frames;

means for performing time-to-frequency transformation to obtain the spectral lines in each frame; and

means for forming bands by grouping neighboring spectral lines within each frame.

23. (Original) The apparatus of claim 21, wherein the means for quantizing of the spectral lines further comprises:

means for estimating bit demand in each band; and

means for allocating bit based on a predetermined bit rates.

24. (Canceled)

25. (Currently Amended) An audio encoder comprising a quantizer to shape quantization noise in spectral lines in each band using local gain, wherein the local gain of the band are estimated as a function of ~~by assigning quantization precision based on~~ band energy ratios and SMRs and to further run a loop to fit the shaped spectral lines in each band within a predetermined bit rate;

a noise shaping module to shape the quantization noise in each band such that a difference between SMR and SNR is held substantially constant in each band; and

an inner loop module to fit shaped band within the predetermined bit rate.

26. (Original) The audio encoder of claim 25, further comprising:

an input module to partition an audio signal into a sequence of successive frames; and

a time-to-frequency transformation module to obtain the spectral lines in each frame,

wherein the time-to-frequency transformation module to form bands by grouping neighboring spectral lines with each frame.

27. (Canceled)

28. (Currently Amended) An article comprising:

a storage medium having instructions that, when executed by a computing platform, result in execution of a method comprising:

encoding an audio signal, based on a perceptual model, by noise shaping spectral lines on a band-by-band basis using their local gains, wherein the local gain of the band are estimated as a function of band energy rations and SMRs, such that the difference between SMR and SNR is held substantially constant for each band.

29. (Original) The article of claim 28, wherein the local gains are derived from energy ratios and SMRs in each band.

30. (Original) The article of claim 29, wherein the energy ratios are computed by dividing energy in each band over sum of energies in all bands.

31. (Currently Amended) A system comprising:

a bus;

a processor couples to the bus;

a memory coupled to the processor;

a network interface coupled to the processor and the memory;

an audio encoder comprising a quantizer coupled to the network interface and the processor to shape quantization noise in spectral lines in each band using local gain, wherein the local gain of the scale band factor are estimated as a function of ~~by assigning quantization precision based on~~ band energy ratios and SMRs and to further run a loop to fit the shaped spectral lines in each band within a predetermined bit rate;

a noise shaping module to shape the quantization noise in each band such that a

difference between SMR and SNR is held substantially constant in each band; and

an inner loop module to fit shaped band within the pre-determined bit rate.

32. (Original) The system of claim 31, further comprising:

an input module to partition an audio signal into a sequence of successive frames; and

a time-to-frequency transformation module to obtain the spectral lines in each frame, wherein the time-to-frequency transformation module to form bands by grouping neighboring spectral lines with each frame.

33. (Canceled)

REMARKS

This responds to the Office Action mailed on September 10, 2008.

Claims 1, 5, 12, 17, 21, 25, 28 and 31 are amended, claims 2, 3, 7, 13, 14, 18, 24, 27 and 33 are canceled; as a result, claims 1, 4-6, 8-10, 12, 15-17, 19, 21-23, 25-26, and 28-32 are now pending in this application.

§103 Rejection of the Claims

The final office action reject claims 1, 4-6, 8-10, 12, 15-17, 19, 21-23, 25-26, and 28-32 under 35 U.S.C. § 103(a) over Davidson et al (US Patent 6,246,345) and Hu et al (US Patent 6,745,162). Applicants respectfully traverse this rejection. For reasons explained below, the claims in question are patentable.

In column 5, lines 38-50 Davidson describes "step 54 determines whether the total of the required allocations differs significantly from the total number of bits that are available for quantization" and "the process returns to step 53 and reiterates this process until step 54 determines that the total allocation required to obtain the proposed quantization step sizes is sufficiently close to the total number of available bits".

Hu describes at step 417 that the DELTA. SMR is calculates for each sub-band. This value compares the difference in SMR for a sub-band as compared to the SMR value for that sub-band in a prior iteration of the loop.

In contrast amended independent claims 1, 5, 12, 17, 21, 25, 28 and 31 recite "local gain of the scale band factor are estimated as a function of band **energy ratios** and **SMRs**" and **not** based on the difference between of SMR value (i.e. DELTA.SMR) of the current and the previous sub-bands. Support for this can be found in Figure 1, and page 4, lines 25-30 and page 5, lines 1-10 of the specification. Also, amended independent claims 1, 5, 12, 17, 21, 25, 28 and 31 recite "shaping the quantization noise in each scale band factor such that a difference between SMR and SNR in each scale band factor is substantially constant". Support for this can be found Page 5 line 4-6, page 6 line 28-30

Davidson and Hu references **fail** to teach or suggest "shaping quantization noise in spectral lines in each scale band factor using local gain, wherein the local gain of the scale band

factor are estimated as a function of band energy ratios and SMRs", as recited in amended independent claim 1, 5, 12, 17, 21, 25, 28 and 31.

Claims 4, 6, 8-10, 15-16, 19, 22-23, 26, 28-30 and 32 depend directly or indirectly from the amended independent claims 1, 5, 12, 17, 21, 25, 28 and 31, so they should be allowable for the reasons presented above.

Applicants respectfully assert that Davidson and Hu references fail to support a ***prima facie*** case of obviousness because as mentioned above, the cited references in combination fail to teach or suggest all of the elements of the Applicants' invention, such as shaping quantization noise in spectral lines in each scale band factor using local gain, wherein the local gain of the scale band factor are estimated as a function of **band energy ratios** and **SMRs**.

For the above reasons, claims 1, 4-6, 8-10, 12, 15-17, 19, 21-23, 25-26, and 28-32 should be allowable over Davidson and Hu references and Applicants request that the rejection be withdrawn.

Allowable Subject Matter

Claims 11 and 20 were allowed.

CONCLUSION

Applicants respectfully submit that the claims 1, 4-6, 8-10, 12, 15-17, 19, 21-23, 25-26, and 28-32 are in condition for allowance and notification to that effect is earnestly requested. The Examiner is invited to telephone Applicants' attorney to facilitate prosecution of this application.

Respectfully submitted,

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Date: November 10, 2008 By ______________________

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